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Critical Issues in the Historical and Contemporary Development of Forensic Anthropology in Australia: An international comparison

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Abstract

The aim of this brief critical qualitative analysis is to examine the development of forensic anthropology in Australia, at a time of significant change in the discipline. It will briefly summarise its historical establishment, making comparative reference to other regions—particularly the United Kingdom and United States, and the influence of the Bali Bombings of 2002, Indian Ocean earthquake and tsunami of 2004 and Black Saturday Bushfires of 2009. The analysis goes on to consider key factors in research in forensic anthropology in the United States, and the development of standards and regulation in the US and UK. The significance of research in post-mortem diagenesis in Brazil—a country sharing aspects of climate, soil types and demography with Australia—is also considered, as well as the significance of patterns of casework encountered in Australia compared with those of other jurisdictions. While forensic anthropology as a discipline has grown remarkably in recent years, this analysis suggests that research and training tailored to the specific pattern of casework encountered in Australia is now essential to support the development of national standards in science, education, and professional regulation. The significance of the establishment of the first taphonomy research facility outside of the US—the Australian Facility for Taphonomic Experimental Research—is briefly considered with reference to what this facility may offer to the development of forensic anthropology in Australia.

Keywords: Forensic anthropology; forensic human identification; forensic science; taphonomy; human decomposition; time since death interval

Introduction

Forensic anthropology (FA) is open to a range of definitions [1-5]. While forensic anthropology could—in the broadest sense—encompass the application of all anthropological knowledge in the interests of the courts [1], it refers in practice to the application of physical anthropology, either generally to ‘problems of medico-legal significance’ [2, 3] or specifically to ‘the analysis of human remains to legally establish identity’ [4]—or, more frequently in contemporary practice, to provide investigative evidence leading to identification legally established by other means—such as DNA profiling [1, 5].

While both the European and American roots of forensic anthropology have been widely acknowledged [2, 3], attention given to other regions and smaller jurisdictions has been relatively sparse and sporadic [6-9]. The aim of this analysis is to very briefly describe the historical development of forensic anthropology in Australia, with reference to European and American influences, and to undertake a brief qualitative assessment of critical issues affecting development in Australia by comparison with the UK and US, and also with Brazil; a country which shares similarities in size and climate—and, to a relative extent, population density—with Australia. The analysis concludes with some cautious recommendations for future priorities in education and training, research, and professional practice.

Historical Development of Forensic Anthropology in Australia

Donlon’s reviews [10, 11] of forensic anthropology and casework in Australia provide many insights into the origins of the discipline. Practice has essentially grown out of anatomy and archaeology—as it has in the UK [4, 12]—with most practitioners reaching the destination of forensic anthropology having first studied one or both of these disciplines. It was anatomists who, originally, were called upon by police when—typically—skeletal remains presented that required the expertise of someone with extensive osteological knowledge. These early anatomists then trained others, some of whom broadened their areas of research and training to include soft tissue, trauma analysis and time since death estimation, and began working more regularly with the police as experts in forensic human identification rather than as anatomical scientists [10]. The first true international acknowledgement of forensic anthropology in Australia as a discipline in its own right came through a presentation by two American forensic anthropologists, Bill Bass—of the University of Tennessee, Knoxville Forensic Anthropology Centre—and Diane France—a world-renowned forensic anthropologist with a sub-speciality in differentiating human from non-human material [13-16], who gave the joint keynote address at a conference held by the Australian and New Zealand Forensic Science Society in Sydney in 1996. As Donlon [10] notes, the development of forensic anthropology in Australia could be seen as being held back relative to that of the United States as, prior to the Vietnam War, it was not the Australian practice to repatriate—and hence identify—war dead as it was in the US. After this event, however, development advanced rapidly as individuals and groups working at different Universities and forensic centres continued to develop research and casework activities—which grew noticeably in

number after 1996 [10]. In the 2000s, however, a whole series of events of national and international significance were to influence the development of Australian forensic anthropology: These included terrorist attacks on tourist areas in Bali in 2002 and on the Australian Embassy in Jakarta in 2004 [17]. The latter incident led to nine fatalities and the former to 202—of whom 88 were Australian. Boxing Day 2004 saw the biggest natural disaster of recent times, the Indian Ocean earthquake and subsequent tsunami led to the deaths of 226,000—including 26 Australians [18]. The ever-present problem of bushfires during the hotter months due to Australia's hot, dry climate precipitated a fire in February 2009, an event that has become known as Black Saturday. This fire caused the deaths of 169 people, all of whom were identified via the Disaster Victim Identification (DVI) process [19].

Although much was learnt from each of these incidents, research and subsequent academic publications regarding the establishment of time death interval to help identify deceased individuals had to rely on case-based evidence to develop Australian standards, as until 2016 there was no forensic facility that allowed the systematic study of human decomposition under controlled conditions in an Australian context.

Contemporary Development of Forensic Anthropology in Australia

Taken together, these events have led cumulatively to a range of developments in forensic anthropology and in the allied disciplines of forensic archaeology, pathology and odontology, each of which have contributed to the investigations concerned [19-22]. The events have also led to a clear recognition of the role of forensic anthropology in mass atrocity and mass disaster victim identification—as they have in other regions [9, 23-25]—as well as in routine casework. Thus, a number of core functions of the forensic anthropologist are now recognised that allow the discipline to aid the judicial process. These include the identification of human remains—both in single death cases as well as mass fatality incidents—and search and recovery of human remains with understanding of the mechanism of disposal, in association with allied disciplines such as forensic ecology¹ [26] and forensic archaeology, and the estimation of time since death, again in collaboration with other disciplines, notably forensic entomology.

Over the past five years research, training, and teaching in forensic anthropology have advanced considerably in Australia—in ways that both mirror and differ from developments elsewhere. In Australia, the terrorist attacks in Bali in 2002 and 2004 Boxing Day tsunami increased awareness amongst forensic practitioners and police forces of the need for the greater inclusion of medical sciences (including forensic anthropology) in the DVI process. Similarly, following the Indian Ocean earthquake and tsunami in 2004, forensic practitioners

¹ Or 'forensic botany' as it is also known, can be defined as the examination of plants and plant matter to determine species and origin. In some cases suspects or victims may leave behind plant parts, spores, seeds or pollen that have adhered to their clothing, skin, hair, etc., or weapons or other items of interest. If the plant species in question is found only in limited areas, its presence may indicate where an item or individual has been, or where a suspect/victim lives. Forensic botanists also analyze stomach contents, wheel arches of cars, etc., to collect botanical evidence that may be relevant in linking suspects, victims, and scenes.

and police in the UK realised that Britain too did not have enough trained police officers to manage such a large and complex recovery effort and to identify and repatriate British citizens as quickly as possible [27, 28]. A representation was made to the British Government, led by forensic anthropologist Professor Sue Black of the Centre for Anatomy and Human Identification, University of Dundee, Scotland, which initiated momentum for a national training program in DVI [29]. As a consequence, the Home Office funded training for 500 police officers in all aspects of mass fatality management and emergency mortuary procedures, including basic forensic practices, to ensure each officer understood the requirements of all the disciplines involved in the process, and to ensure that when—not, sadly, if—another mass fatality involving British citizens occurred, Britain would be ready to respond to the highest standards [30].

In Australia there are a number of centres producing the bulk of forensic anthropology research, and as a result of the size of the country, it makes sense to discuss these on a State-by-State basis (although the discussion here offers examples only, and is not intended to summarise all of the research currently taking place in Australia). In the west, the University of Western Australia has a Forensic Anthropology Group, whose research focuses on the development of morphometric tools and standards for application to Australian remains, and the development of a 'Human Identification Package' for use in Australian casework and DVI deployments, which includes the formulation of population-specific anthropological standards [31]. The majority of recent research undertaken has focussed on living individuals, using advanced technologies to improve our understanding of age and sex estimation [32-36].

In Victoria, the Victorian Institute of Forensic Medicine (VIFM) [37] is one of the leading forensic medicine facilities in Australia, if not worldwide. As with many forensic disciplines, the casework tends to dictate the research priorities, and estimation of time since death is always a key factor when trying to identify unknown human remains, or interpret a crime scene and unravel the order of events that have taken place surrounding a fatality. The VIFM employs two forensic anthropologists, who have in the past 10 years published research on the requirements for missing persons' data, and the specific problems associated the Australian context—including the fact that each of Australia's states and territories operates its own Missing Persons Unit, with distinct state and territory legislation [38]. More recently, research published by the VIFM has focused on DVI, a specialized area of forensic anthropology that requires highly skilled forensic practitioners able to distinguish and identify admixed, fragmented, or highly decomposed individuals from some of the most complex forensic scenes. Case-based research has examined the use of advanced imaging techniques and their application to identification in multiple fatality incidents [21, 39], and the forensic anthropologist's role in identifying burnt remains using the 2009 Black Saturday bushfires in the state of Victoria as a case study [24].

New South Wales has a number of individuals undertaking research, teaching, and casework, with the University of Sydney, the University of Western Sydney, the University of

Wollongong, and the University of New England all undertaking work in the field of forensic anthropology. The University of Sydney, for example, offers a forensic anthropology consultancy service, as well as research supervision [40], and a research focus on improving methods of discriminating between human versus non-human bone [41] and sexual dimorphism in the dentitions of Australian populations [42]. Research at the University of Western Sydney focuses on improving methods of estimating time since death [43], and the University of Wollongong produces facial reconstructions when an unknown skeleton is found [44, 45] (facial anthropology being a sub-speciality of forensic anthropology).

At the Australian National University, researchers are investigating time since death [46, 47], and have been using animal proxy's for this research for some time [48-50], as well as reanalysing sex classification methods [51]. In South Australia, researchers at the University of Adelaide publish research and casework focussing on the utilisation of prostheses for human identification [52] and improving methods of craniofacial identification [53-55], as well as improving methods of age estimation for juveniles [56-59].

Further north, the University of Queensland hosts the Laboratory for Human Craniofacial and Skeletal Identification (HuCS-ID Lab), a newly-established forensic bioanthropology laboratory that lists human anatomy, quantitative shape analysis, statistical computing, photography, robotics, and medical imaging as skills utilized within the facility to improve and quantify human identification methods [60]. The laboratory is intensively research active, and much of the published work focuses on facial identification [53-55, 61-66] and the development of a computerized clavicle identification system designed principally to resolve the identities of unknown individuals based on the comparison of ante-mortem chest radiographs and 3D scans of clavicles [67, 68]. Practitioners at the Queensland University of Technology undertake research that largely focuses on the morphometric analysis of specific skeletal elements to improve understanding of sexual dimorphism [57] and evaluating established ageing methods [56, 58, 59] on Australian populations.

In addition to the work being undertaken to improve methods to locate, recover, and identify human remains, research is also directed at identification of living individuals in forensic cases—an important emerging issue in forensic anthropology [69-71].

Courses in Forensic Anthropology

One measure of the degree of acceptance of a scientific discipline is the extent of its establishment in the academy. A search for courses in forensic anthropology in a particular region illustrates how forensic anthropology is viewed more widely and if it is recognised as a discipline in its own right. If a plethora of courses exist at both undergraduate and graduate level, it can be argued that the science has reached a critical mass of practitioners and has attained a level of professionalism whereby its relevance and importance has been recognised at an institutional level. In the UK, for example, specific forensic anthropology undergraduate courses have existed since 2006, and a search today would reveal numerous options available for those wishing to study this fascinating field of science in Britain. Such an

assessment may be weakened however, by the critical assertion that forensic science is used cynically by many Universities in order to drive up admissions [72], without any particular concern for wider issues (such as employability of graduates).

A second measure of acceptance may be the level of professionalism indicated by evidence of accreditation and certification. Using the UK as an example once more, in 2011 the British Association for Forensic Anthropology (BAFA) was formed, with the Royal Anthropological Institute as the professional governing body. A three-level certification process is a core aspect of accreditation with BAFA, the aim of which is professionalization of the discipline, allowing end users (the police and legal professionals) to determine who is suitably qualified and experienced to undertake casework, as well as providing a career pathway for future practitioners [28, 73].

In the United States, various courses are available for students to study forensic anthropology at both undergraduate and postgraduate level, and nine are listed by the science's accreditation body—the American Board of Forensic Anthropology [74], which provides information to students on where they can study under the guidance of a certified forensic anthropologist; thereby ensuring a consistent standard of teaching across programmes. That the science has its own board—established in 1977—with a list of accredited practitioners is again evidence of the professionalism of the discipline in the US.

A similar search for 'forensic anthropology courses Australia' as a measure of acceptance in the academy reveals few options. The Australian National University offers forensic anthropology as a minor component, but not within a Bachelor of Science program, but rather as part of a Bachelor of Arts [75]. Many other Universities offer single units in forensic anthropology, or include forensic anthropology in general units about forensic science. It seems no single, science-based forensic anthropology undergraduate course can be sourced in Australia. A search for Masters courses provides a similar picture: forensic anthropology can be taken as a subject with a forensic science module or as a minor component, but only two postgraduate courses listed, a Masters in Forensic Anthropology (by coursework and dissertation) at the University of Western Australia, available from 2017, and a Master of Forensic Medicine with a number of streams and modes (research and taught), depending on the student's requirements at Monash University from 2017. Importantly, the Monash degree specifically notes "Students can choose to complete a research stream that will provide a pathway to a higher degree by research."² and forensic anthropology is covered in this degree, although only as a single unit rather than a stream in itself.

The question must therefore be asked; where are Australia's prospective forensic anthropologists studying, and how is the discipline to move forward in Australia with so few suitable courses being available? It could be argued that with a limited number of positions available as practitioner forensic anthropologists, perhaps this explains the dearth of dedicated forensic courses in Australia. However, the UK is in the same position as Australia, in that there are few positions available for trained FAs, yet there are significantly more

² For more information see <https://www.monash.edu.au/pubs/handbooks/courses/M6009.html>

courses and avenues for professional development and recognition. Australia could certainly benefit from having more forensic anthropologists, with some police forces still not fully embracing the benefits of consulting a FA when bones are found that require identification, as the discipline is still not widely acknowledged as a core forensic competency. In a country where remains (human or otherwise) often fully skeletonise very quickly as a result of environmental conditions, this would seem a imitation of current forensic investigative practice.

Turning to the United States again for comparison, we see that the US has a stronger history of forensic anthropological training and large-scale focused research, potentially as a result of the fact the US has a much larger population and high crime levels, leading to a corresponding increase in the need for forensic anthropologists to undertake casework. The first outdoor forensic anthropology research facility was established at the University of Tennessee, Knoxville, in 1981 after forensic anthropologist Bill Bass recognised the need for systematic studies to support the forensic casework he was undertaking. The site in Knoxville was an excellent start and remained the only site of its kind for 25 years. However, five others have since opened across the US—Western Carolina University in 2006, Texas State University in 2008, Sam Houston State University in 2010, Southern Illinois University, Carbondale in 2012, and Colorado Mesa University in 2013. Three other sites are planned in Florida, Wisconsin and Pennsylvania to study the science of decomposition. Having so many sites spread across the country with such variations in climate, altitude, latitude, scavenger species, etc., provides unrivalled potential for research in forensic anthropology, helping forensic anthropologists to offer more reliable information to police about core aspects of forensic casework involving deceased individuals—including, amongst other things, time since death—based on empirical evidence gained from the Forensic Anthropology Data Bank [76, 77], a database comprising information on nearly 3,400 cases from all over the US at the time of writing [78].

Accreditation for Forensic Anthropologists

The second indicator of acceptance and professionalism is evidenced by an accrediting board providing certification to qualified experienced forensic anthropologists; also lacking in Australia, as no such accrediting body exists (although accreditation is currently being discussed by the Forensic Anthropology Scientific Working Group³ [79], approved by the Australia New Zealand Policing Advisory Agency and the National Institute of Forensic Science – see <http://www.anzpaa.org.au/forensic-science/nifs-home>). This means anyone can claim to be a forensic anthropologist and the end user—largely the police—have few ways to check the suitability of that person to practice and provide evidence in forensic cases.

In forensic anthropology, academic work, professional practice and professional standards are clearly interdependent. It would seem pertinent, then, that we learn the lessons from the

³ The Forensic Anthropology Scientific Working Group (SWG) in Australia is part of the Medical Sciences Specialist Advisory Group (MSSAG). For more information see Blau *et al.* 2012 [79].

UK and US, where the forensic world has been rocked in recent years by reports evaluating the standard and quality of forensic science in these jurisdictions. In 2009, the National Academy of Science (NAS) in the US published its report '*Strengthening Forensic Science in the United States: A path forward*' [80], which was critical of reliability and training programs:

Too often they [forensic science facilities] have inadequate educational programs, and they typically lack mandatory and enforceable standards, founded on rigorous research and testing, certification requirements, and accreditation programs. Additionally, forensic science and forensic pathology research, education, and training lack strong ties to our research universities and national science assets. [80: pp. s10]

In the UK, the Home Office published the UK's equivalent report '*Research and Development in Forensic Science: A review*' [81]. Among a number of key recommendations, the report states:

Forensic science researchers, providers and users should all pay particular attention to appropriate communication within the research landscape, especially in view of the multifaceted nature of research and development in forensic science. [81: pp. 3]

Both of these comments could be said to apply to forensic anthropology in Australia, and indeed forensic science provision across the world [82]. In 2012, Professor Alistair Ross (who was until 2015 Director of the National Institute of Forensic Science in Australia) applied these two reports' findings to the Australian landscape, with a view to strengthening the field of forensic science going forward [82]. What Professor Ross made clear is that the field of forensic science as a whole is well placed in Australia, which has a National Institute of Forensic Science, Specialist Advisory Groups (eight in total: biology, chemical criminalistics, document examination, electronic evidence, field and identification sciences; illicit drugs, medical sciences, and toxicology) established within the Australia New Zealand Policing Advisory Agency (ANZPAA) and several Scientific Working Groups (one of which is medical sciences, which includes anthropology). There is also an ANZPAA Disaster Victim Identification Committee (ADVIC), which falls within the Agency's National Institute of Forensic Science (ANZPAA-NIFS) directorate [83]. An anthropology representative is included in this group, along with other forensic disciplines, and a DVI Commander from each policing jurisdiction in Australia and New Zealand. Forensic standards have been published, together with discipline standards for DNA analysis (AS 5388.1 Forensic Analysis Part 1: Recognition, recording, recovery, transport and storage of material [84]; AS 5388.2 Forensic Analysis Part 2: Analysis and examination of material [85]; AS 5388.3 Forensic Analysis Part 3: Interpretation [86]; AS 5388.4 Forensic Analysis Part 4: Reporting [87], and AS 5481 Minimizing the risk of contamination in products used to collect and analyze biological material for forensic DNA purposes [88]). However, the question remains of how well these

standards relate to the recovery and identification of human remains by forensic anthropologists specifically.

Here and 'AFTER'

This brief qualitative analysis suggests key issues can be critically identified that affected or continue to affect the development of forensic anthropology in Australia. An important stimulus in the US lacking in Australia was the need to repatriate war dead—although this may now be changing with the news in mid-2016 that 33 Australians buried in cemeteries in Malaysia and Singapore were repatriated following historical conflicts; one of the largest military repatriations in Australian history [89]. This could indicate a shift in military thinking towards Australian military personnel buried overseas after international conflict, and which would in turn require additional forensic anthropological services going forward to assist with future repatriations, thereby further stimulating the development of the discipline.

Following dissemination of US experience in Australia, forensic anthropology grew steadily, and expanded greatly in response to the Bali Bombings of 2002, the Indian Ocean earthquake and tsunami of 2004 and the Black Saturday bushfires of 2009. Buck and Briggs [17], for example, note the establishment of fully trained DVI teams in most Australian States and Territories post-Bali, and the recognition of the key role of the forensic anthropologist in investigation and communication. The contribution of Australian forensic anthropologists to the investigation of humanitarian abuses in East Timor [90] and elsewhere is also of critical importance—in producing empirical evidence of identification and of events, and as participants in the transitional justice process [90].

Casework is currently is being undertaken by a number of practitioners and academics, and the importance of standardization of procedure and reporting is widely recognized across forensic science disciplines. Undergraduate and postgraduate educational provision is inconsistent, however. There is an over-riding body to represent forensic anthropologists (the ANZPAA-NIFS approved SWG) although not all FAs contribute to this group, and no accreditation process currently exists to assist in career development for new forensic anthropologists in training or to assist the police in determining which individual's services to employ. As a result, the definition, role, and regulation of forensic anthropology remains the subject of discussion and debate (Evison et al. 2012, p. 99-100).

Dedicated undergraduate and postgraduate taught courses in the discipline and an accreditation programme are required to ensure students—the future practitioners of forensic anthropology in Australia—receive consistent suitable guidance as to the standards and professional expectations required of them by the criminal justice system.

A number of authors have offered opinions regarding the possible future development of forensic anthropology from a variety of perspectives [69, 70, 91]). Işcan [69, 91] emphasises a need for population standards and research on trauma, taphonomy, the estimation of time since death, and craniofacial identification. Cattaneo [70] also highlights the need for

professionalization and training, species identification, and research in post-mortem interval determination.

In Australia, a significant new development was the opening of a facility in Sydney in 2016 that has the potential to revolutionise forensic anthropology by providing the opportunity to study human decomposition in an Australian context for the first time. The Australian Facility for Taphonomic Experimental Research (shortened to 'AFTER') is a 12-acre (~5 hectare) site located in bushland on the western outskirts of Sydney, near the Blue Mountains, in New South Wales. The project to establish the facility was supported by a multidisciplinary team of forensic science practitioners and police forces, and was part-funded by the Australian Research Council [92] in association with the project partners. Forensic anthropologists are leading research projects at the facility examining a range of anthropological factors, including all basic data collection relating to time since death and decomposition rates in a bushland environment on the outskirts of Sydney. The research being undertaken at AFTER will offer invaluable information to help identify long-term unidentified deceased persons in Australia, helping to reduce the number of unidentified persons buried in numbered graves around the country.

This is a very important development for forensic science in Australia as, according to the Australian Federal Police, over 35,000 people (or 170 per 100,000 in the general population) are reported missing annually. Whilst 98% are found, mostly alive and unharmed, 3,330 are currently listed as 'long-term' missing (based on the total number of missing persons reports 2008-2015 where the person is not yet located), meaning they have been missing for more than 6 months. Between 0.1-3.3% may never be found [93], others may be deceased and their remains may be in various stages of decomposition when discovered.

All identifications rely on the ante-mortem and post-mortem matching (via dental or fingerprint comparisons, a DNA match, or a evaluation of a unique medical condition), the only process that can confirm an identity to the required legal standard. Consequently, even after human remains are found, individuals may remain unidentified if no missing person's report has been made that a biological profile of the deceased can be compared against, or if the decedent's ante-mortem information is not stored on a forensic database that can be accessed—most commonly DNA or fingerprint databases. This is why so many unidentified deceased individuals remain in morgues and unmarked graves around the country, as no information is available to facilitate identification.

This situation has been exacerbated in Australia due to the extreme environmental conditions together with the large size of the country. The generally hot, sometimes humid, sometimes dry climate can lead to expedited or retarded decomposition, and the size of outback areas means that even natural deaths can go undetected for many weeks, if not months or years. It could be suggested that the strength of the sun is also likely to leach all of the organic component out of bone more quickly than in cooler climates, and therefore osteological elements may become weaker and disintegrate more quickly in Australia compared to areas of the US, for example, from where we have some data as a result of the research of

taphonomy facilities already established across the United States. In Australia, however, lack of data from representative contexts when attempting to provide investigative information, including time since death—a fundamental factor that needs to be established at the very beginning of an investigation into the death of an unknown person—means forensic anthropologists have had to resort to providing very large approximations in terms of timescales, which in some cases do not help narrow down the interval in any meaningful way. This is not a criticism of the forensic anthropologist, but rather a statement about the lack of information available to help them provide meaningful estimates. Improving estimates of time death interval will therefore be very useful in death investigations in Australia, increasing the speed at which identifications can be made.

An illustrative case in point is that of 'Angel', whose remains were found in August 2010. A group of trail bike riders discovered the skeletonised remains of a young woman in bushland in Belanglo State Forest, off the Hume Highway between Sydney and Canberra, in New South Wales. The majority of the female's remains were recovered, which included a skull and pelvis, together with all long bones. In addition, blonde hair of three distinct lengths was found which belonged to the victim, who died a violent death, and a t-shirt was also found in association with the remains—the only item of the female's clothing recovered—with a distinctive motif including the word 'Angelic'. Thus, she was dubbed 'Angel' by the popular press. A biological profile was provided by anthropologists from the Department of Forensic Medicine, Sydney. The victim was determined to be of Caucasian ancestry, and aged between 15-25 years at the time of her death. The time since death interval was estimated to be between 6 months and 10 years, based on the fact the remains were fully skeletonised, as well as other contextual information. A facial reconstruction was undertaken [44], and the image of what the female may have looked like in life was publicised. The police were received a number of potential leads, but for many years none proved fruitful in identifying the victim. The police exhausted every potential avenue to try to identify this young woman [94], including using the media and academic publications to try to generate further information [44]. This case was problematic for a number of reasons; one of which being that it was not possible to narrow down the time since death window through analysis of the skeletal remains. Six months to ten years is a very significant time span, and, as no missing persons report matched the deceased between those times, the young woman remained unidentified. As a result, the police had to use the origins of clothing found with the remains to narrow down when the clothing could have been bought and distributed, in an attempt to estimate time since death more accurately to help their search for potential identities. It was not until 2015, when a caller to *CrimeStoppers* (an Australia-wide anonymous police tip-line) gave investigators a lead to the victim's identity that the remains were finally identified by a DNA comparison between the remains and an ante-mortem blood sample [94]—further permitting a comparison of the original facial reconstruction with ante-mortem photographs of the victim [44, 95]. A period of just under two years had elapsed between the victim last being seen

alive and her remains being discovered, and a further five years elapsed prior to her identification.

Brazil: A comparative territory

Problems encountered in human identification from skeletal remains in tropical climates akin to those of Australia have been the inevitable subject of research and professional practice in Brazil, a country of approximately similar size, where sparsity of population outside of urban centres means that bodies are often not quickly discovered, and where climatic and soil conditions cause skeletonisation and biomolecular diagenesis to advance rapidly post-mortem, frequently confounding attempts at DNA profiling using protocols developed in temperate climatic zones. In Brazil, collaborative research has specifically focused on advancing understanding of post-mortem histological changes in human bone interred in tropical soils [96-99] and combination of forensic anthropology with DNA recovery [100]—as has been attempted in the US [101, 102]. A further problem recognised in Brazil [103] and elsewhere [69, 70, 91]—and as Donlon has noted regarding Australia [10]—is an absence of representative reference skeletal collections, which can be used in the development of pertinent standards, given the highly admixed population. In an international comparison examining the utility of forensic anthropology in criminal and civil investigations, Evison and colleagues [104-106] found that the patterns encountered in caseloads between centres were remarkably consistent internationally, chiefly varying according to the local homicide rate and use of firearms, and the extent to which the local environment fosters concealment and advances skeletonisation. Patterns of skeletonisation encountered in Brazil and Australia are similar [10, 105], for example, but differ from the UK where opportunities for concealment and skeletonisation are minimal by comparison. The number of cases of burned bone so far reported in Australia appear small relative to both the UK and Brazil. Whilst it is recognised that not all cases will be published for various reasons, given the frequency of bushfires in the Australian natural environment, this lack of published case histories may reflect a sampling effect attributable to the large proportion of prehistoric Aboriginal remains included. Evison *et al.* used an attrition model [105] to examine impediments to case advancement. On the basis of their findings in relation to attrition and with reference to other studies, they propose that education and research could be better tailored to casework, suggesting the following topics could be targeted:

- Positive identification of faunal remains
- Understanding the significance of case provenance and the extent of preservation
- Estimation of time since death (including distinguishing archaeological cases)
- Distinguishing peri- and post-mortem trauma
- Identifying and understanding the significance of burning
- Identifying and understanding the significance of gunshot trauma
- Identifying and understanding the significance of surgery

- General and local knowledge of the provenance and pattern of forensic anthropology cases
- Collaborative use of forensic odontology and forensic DNA analysis
- Improving the effectiveness of forensic facial reconstruction

The science of forensic anthropology has in some ways developed in both a parallel manner, as well as separately, from the discipline in other parts of the world, largely led by the researchers working in the field and the individual needs of each country in terms of what types of cases require the services of a forensic anthropologist. The history of a science will inevitably influence its current standing and future direction, and as a result of the fact that forensic anthropology is a fairly new discipline in Australia, it could be argued that the science is in some ways not as advanced as in the UK or US, at least in terms of courses available at tertiary level or accreditation and professional development.

Conclusions

In her 2008 review, Australian forensic anthropologist Denise Donlon stated that forensic anthropology in Australia was “on the cusp of being recognised as a discipline in its own right” [10]. For reasons that Donlon discusses, this situation contrasts somewhat with the discipline’s position in the UK and—most clearly—the US, and highlights the need for further education and research, and development of professional standards.

Forensic anthropology in Australia has moved beyond its foundations as a subsidiary activity of anatomists and archaeologists. Expansion occurring from the late 1990s was further stimulated by the unfortunate events of the Bali Bombings of 2002, the Indian Ocean earthquake and tsunami of 2004 and the Black Saturday bushfires of 2009, as well as by contributions to the humanitarian investigations in East Timor and elsewhere. In order to develop to a further stage of academic and professional independence—as exemplified by the US, in particular—forensic anthropology in Australia will benefit from the establishment of a governing body, of which all FAs are members and with associated accreditation and certification processes, and development of high quality specialist undergraduate and postgraduate education and training tailored to accreditation. New research—including unique studies facilitated by the establishment of the Australian Facility for Taphonomic Experimental Research—addressing post-mortem process and establishment of reference databases targeted to patterns of casework encountered in Australia—will greatly advance knowledge in the discipline.

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